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EXAMINER	
CHANG, EDITH M	
ART UNIT	**PAPER NUMBER**
2634	14

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/370,178	LI ET AL.	
	Examiner	Art Unit	
	Edith M Chang	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 March 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed March 31 2004 have been fully considered but they are not persuasive.

Argument: The invention of the present application uses one-direction processing of SOVA to achieve the minimum decoding latency, but also uses the exact probability computing for each bit as MAP to achieve the best performance.

Response: The invention of the present application uses a soft output Viterbi Algorithm (SOVA) which is a VA (Viterbi Algorithm) using soft decisions to calculate its metrics, but also decides in a soft way by providing reliability information together with the output bits. The reliability information can be the log-likelihood function. Blaker et al. uses soft decisions in the VA (column 8 lines 59-61 wherein the Blaker et al.'s VA provides a method of soft symbol decoding that reflects probabilities) and uses the exact probability computing for each bit (column 9 lines 7-10 where each bit probability component is used) as claimed.

Argument: The classical Viterbi algorithm as disclosed by Blaker et al. is to estimate the entire coded block of data and aims to maximize the probability of entire blocks and a hard decision is made. In Blaker et al., the soft output is defined as an accumulated branch metric, namely, the Euclidean distance or Manhattan distance as sown in Table 1.

<u>Response:</u> Blaker et al. discloses a method comprising determining a probability of reaching the state (column 9 lines 5-10 wherein the symbol contains probability components, column 3 lines 42-50, column 3 line 55-column 4 line 5); providing probabilities for respective symbol values (column 4 lines 2-20); and providing a probability for each symbol (column 4 lines 45-46) *as cited in the claim*. In Blaker et al. the soft output is defined as soft decision decoding with 8 bits for more than two output levels (FIG. 5-7, column 3 lines 4-11).

<u>Argument:</u> In the SOVA of the instant invention, the soft output is defined as LLR (Logarithm Likelihood Ration) which is clearly distinct from Blaker et al.

<u>Response:</u> Hladik et al. teaches the SOVA or MAP decoder calculating the logarithm of likelihood ration defined in column 5 lines 1-15 which is the LLR. As Blaker et al. teaches the soft decision decoding in the VA, it would have been obvious to a person of ordinary skill in the art to have the LLR taught by Hladik et al. in Blaker et al.'s method. This combined/modified method is a typical SOVA calculation (column 4 line 66-column 5 line 14) and gain computational advantages (column 5 lines 7-8).

<u>Argument:</u> In a pure MAP algorithm disclosed by Hladik et al. the path reliability metric is defined as an approximated log-logarithmic ration of the probability.

<u>Response:</u> The log-logarithmic ration of the probability defined in Hladik et al. *is the log-logarithmic ration of the probability* in column 3 line 60, column 5 lines 10-14, column 9 lines 31-35, and column 12 line 60.

Argument: The fundamental difference between Belveze et al.'s method and the decoding method using the SOVA in accordance with Claim 18 is that the former is the bi-directional decoding and the latter is one-pass decoding.

Response: Belveze et al. teaches the q-uplet of symbols of SOVA used in the rationale of rejections of claims 12 and 13. The limitations (e.g. the differences stated in the arguments: bi-directional or one-pass decoding if defined in the specification) in the specification do not read in the claim when these limitations are *not recited in the claim* (see MPEP 2111).

Argument: The subject matter defined by Claims 1, 8, 15, and 18 is not obvious from any or a combination of Blaker et al., Hlakid et al. and Belveze et al.

Response: Claims 1, 8, 15, and 18 are rejected over Blaker et al. in view of Hladik et al. As Blaker et al. teaches the soft decision decoding in the VA (column 8 lines 59-61 wherein the Blaker et al.'s VA provides a method of soft symbol decoding that reflects probabilities) and the exact probability computing for each bit as MAP (column 9 lines 7-10 where each bit probability component is used), at the time of invention, it would have been obvious to a person of ordinary skill in the art to have the vector representation of probabilities/probability ration/LLR taught by Hladik et al. (column 3 line 50-column 4 line 5, column 4 line 65-coumn 5 line 14, column 9 lines 25-40) in Blaker et al.'s method. This combined/modified method is a typical SOVA calculation (column 4 line 66-column 5 line 14) and gain computational advantages (column 5 lines 7-8).

The rejections are upheld as the follows:

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-11, & 14-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Blaker et al. (US5550870) in view of Hladik et al. (U.S. Patent 5721745).

Regarding **claims 1 & 8**, except explicitly specify the vector representation of probabilities, Blaker et al. discloses all subject matter: a method of processing information/decoding q-ary encoded information symbols where q is a plural integer (column 7 lines 10-12, where the symbol is 8 bit), using a soft output Viterbi algorithm (Abstract), comprising the steps of:

(a) determining a probability of reaching the state via each transition path, and a total probability of reaching the state (column 9 lines 5-10 wherein the symbol contains probability components, column 3 lines 42-50, column 3 line 55-column 4 line 5); and

(b) providing at least probabilities for respective symbol values for reaching the state by summing products of the probability of reaching the state via the respective paths with respective elements of vectors provided for previous states from which the state can be reached via the respective paths (column 4 lines 2-20); and

(c) providing a probability for each information symbol from respective elements of the at least one vector for all of the possible states of the trellis for a respective symbol time (column 4 lines 45-46).

Where the (a), (b), and (c) for each and every path (column 3 lines 42-49, where the Viterbi decoder starts at the starting point/state and considers all possible state combinations/ Paths that includes steps a, b, and c), and (b) and (c) for each and every symbol (column 3 lines 55-67, column 4 lines 45-47, wherein the path metric calculates for each symbol instant, the (b) and (c) are steps of path metric).

However Hladik et al. teaches the vector representation of probabilities/the likelihood ratios for SOVA (column 3 line 50-column 4 line 5, column 4 line 40-column 5 line 15, column 9 lines 25-40). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the representation of probabilities/ likelihood ratios taught by Hladik et al. in Blaker et al.'s method as a typical SOVA calculation (column 4 lines 66-67) and to gain computational advantages (column 5 lines 7-8).

Regarding **claim 4**, Blaker et al. discloses the symbol values have a plurality of q values and one vector of probabilities for respective symbol values comprises q probabilities (column 7 lines 11-14, Table 1, column 4 lines 39-41 & lines 60-63, where MLSE estimates the digital data sequence having the maximum probabilities of transmission using the Viterbi algorithm).

Regarding **claims 2**, **5-6**, & **9**, Blaker et al. does not specify the probability ratios and logarithmic probabilities, however Hladik et al. teaches probability ratios (column 5 lines 1-7) and logarithmic probabilities (column 5 lines 7-11) for the binary values. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the

probability ratio/ logarithmic probabilities taught by Hladik et al. in Blaker et al.'s method as typical SOVA calculation (column 4 lines 66-67) and to gain computational advantages (column 5 lines 7-8).

Regarding **claims 3 & 10**, Blaker et al. does not specify the probability ratios for q values, however Hladik et al. teaches probability ratios (column 4 line 66- column 5 line 7) for the symbol with plurality values, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the probability ratios taught by Hladik et al. in Blaker et al.'s method in the one vector for each state comprising at least q-1 vectors of probability rations as typical SOVA calculation (column 4 lines 66-67) and to gain computational advantages (column 5 lines 7-8).

Regarding **claim 7**, Blaker et al. does not specify two vectors of probabilities, however Hladik et al. teaches two vectors of probabilities, one for each of the binary values (column 4 lines 11-13, column 5 lines 6-7). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the vectors of probabilities of binary symbols taught by Hladik et al. in Blaker et al.'s method where receiving series of binary data (column 3 lines 49-50 '870) to have more efficient computation.

Regarding **claim 11**, Blaker et al. does not specify providing logarithmic probability rations, however Hladik et al. teaches the logarithmic probability ratios (column 4 line 66- column 5 line 15). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the probability logarithmic probabilities taught by Hladik et al. in Blaker et al.'s method to gain computational advantages (column 5 lines 7-8).

Regarding **claims 14 & 16**, Blaker et al. dose not teach the normalizing the total probabilities, however Hladik et al. teaches the normalizing the total probabilities (column 6 lines 49-63, column 8 lines 7-10 step (ii), column 9 lines 40-52). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the normalization in Blaker et al.'s method to have better performance and efficient memory usage (column 2 lines 11-14).

Regarding **claim 15**, except explicitly to specify the probability ratio, Blaker et al. teaches all subject matter claimed (refer to the rationale of claim 1), however Hladik et al. teaches probability ratios (column 5 lines 1-7) and logarithmic probabilities (column 5 lines 7-11) for the binary values. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the probability ratio/ logarithmic probabilities taught by Hladik et al. in Blaker et al.'s method as typical SOVA calculation (column 4 lines 66-67) and to gain computational advantages (column 5 lines 7-8).

Regarding **claim 17**, Blaker et al. discloses a decoder to carry out the method (column 3 lines 38-50, FIG. 1).

Regarding **claim 18**, except explicitly specify two vectors of logarithmic probabilities for the symbol representing a binary one or zero, Blaker et al.'s method has all the subject matter claimed (refer to the rationale of claim 1): updating fro successive symbol times tow vectors (receiving series of binary data, column 3 lines 48-50); determining probabilities for each state; combining the probabilities to determine the probability of reaching the state (column 3 lines 65-67); merging probability vectors for the respective states; and determining a probability at the start of the survivor path for all the possible states at a respective information symbol time

(column 4 lines 2-20, lines 28-36); and Blaker et al. disclose the symbol instant/time, and all the well known basic Viterbi algorithm steps claimed. However Hladik et al. teaches the binary representing symbol probabilities (column 5 lines 1-15). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the probabilities representing binary zero and one taught by Hladik et al. in Blaker et al.'s method as typical SOVA calculation (column 4 lines 66-67) and to gain computational advantages (column 5 lines 7-8).

Regarding **claim 19**, Blaker et al. dose not teach the normalizing the total probabilities, however Hladik et al. teaches the normalizing the total probabilities (column 6 lines 49-63, column 8 lines 7-10 step (ii), column 9 lines 40-52). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the normalization in Blaker et al.'s method to have better performance and efficient memory usage (column 2 lines 11-14).

Regarding **claim 20**, Blaker et al. discloses a decoder to carry out the method (column 3 lines 38-50, FIG. 1).

4. Claims 12 & 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Blaker et al. (US 5550870) in view of in view of Hladik et al. (U.S. Patent 5721745) as applied to claims 10 and 8 above, and further in view of Belveze et al. (U.S. Patent 6389574 B1).

Regarding **claims 12 & 13**, Blaker et al. does not explicitly specify the Q-ary, further Belveze et al. teach the Q-uplet of symbols (column 3 lines 15-20, column 6 lines 5-10) where Q is an integer at least equal to 1. When Q=1 it is the binary (M-ary where M is 2) wherein q=2. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have the Q-uplet teaching by Belveze et al. in Blaker et al.'s method to detect a discrete symbol

sequence from an observation signal the production of which can be described by means of a trellis states and branceds being associated with a single Q-uplet of discrete symbol (column 3 lines 15-20).

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edith M Chang whose telephone number is 703-305-3416. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on 703-305-4714. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Edith Chang
June 4, 2004

Chieh M. Fan

CHIEH M. FAN
PRIMARY EXAMINER